

# Biochemistry I CHE 4310

Spring 2020

Tues & Thurs 10am-11:50am (room SI 3079)

Course Website: <http://BonhamChemistry.com/>

Instructor: Dr. Andrew J. Bonham Office Hours: Tues & Thurs 12:30-2; or <http://Bonham.YouCanBook.Me>

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## Why Study Biochemistry?

Biochemistry is the study of the chemical processes of living organisms—both those in the world around us and ourselves. This course is an introduction to the chemistry of living systems with emphasis placed on metabolism, bioenergetics, molecular strategy, and regulation. Applications to the related fields of nutrition, human physiology, and medicine are stressed. A solid understanding of biochemistry will provide a better understanding of how your body works (whether that be in exercise, nutrition, or disease response) and give insight into the endless, fascinating examples of the beauty and complexity of the living world.

## What do I expect from you? How can you succeed at this course?

Biochemistry is a complex topic, and while I believe that every student can succeed at this course, like any challenge, certain expectations must be met for you to succeed.

- **Regular Attendance and Daily Practice:** Science and math are their own language, with specialized vocabulary and ways of approaching problems. Just like the study of a foreign language, I expect regular attendance and daily practice. If you cannot commit to thinking about, and solving problems in, biochemistry *every day*, you will not acquire enough skill to confidently pass the exams and master this topic to the level that you will need for future careers.
- **Plan for the Future:** I expect you to be aware of the lecture schedule and exam dates, and plan accordingly. I expect at least two weeks notification for any quiz you may miss (see Homework & Quizzes, below), and there will not be any flexibility on the date and time of the Final Exam. Review the schedule now, and plan for the future.
- **Pay Attention and Work Through Problems:** It is exceedingly easy to fall into the trap of half-listening to lectures, nodding along with the material, only to find that you cannot answer the test questions. You cannot succeed by listening alone. I expect you to take notes, engage with the class and your classmates, do the homework exercises, and commit to the often-difficult process of learning unfamiliar topics. Note well that simply looking at a problem set, then at the answer key, and saying to yourself, “That makes sense,” is not the same as actually solving the problem!

## What can you expect from the instructor?

I will give clear, relevant, on-time lectures that encourage class participation. I will provide clear assignments, clear and fair grading policies as outlined in this syllabus, and relevant practice problems. I will offer reasonable availability outside of class (e.g., office hours). Through my actions, I will encourage your understanding and enjoyment of the science of biochemistry.

## Required Materials:

- **Biochemistry: Concepts and Connections**, 1st or 2nd ed. Appling. Buying it used makes a lot of sense.
- Scientific or Graphing Calculator for Quizzes (no cell phones, laptops, tablet computers, or other web devices).
- Sapling Learning Subscription, <http://www.saplinglearning.com> Instructions available at the course website!

## Reading:

The course's textbook Appling Biochemistry is a good, informative, and even fun read. Reading the assigned chapters will improve your understanding of the material immensely—there is only so much lecture time, and a world of interesting things to learn. Additionally, the practice problems and Sapling homework draw from the book, and quizzes will also be based on that content. If you attend lecture, read the textbook, and do the homework problems, you will be well prepared to succeed.

## Class Participation / iClickers:

Our course will have interactive worksheets guided by the instructor and a learning assistant, and participation in them is vital. This class will also use the i>clicker evaluation system for in-class responses. These responses, regardless of whether they are “correct” answers, and your class participation will constitute a 10% participation portion of your grade.

## Homework:

We will be using the Sapling Learning online homework system ( <http://www.saplinglearning.com> ). Additionally, you may want to do practice problems from the textbook, and review sheets that I will provide before tests. There is no way around the need to actually solve biochemistry problems; doing homework is your best way to ensure a good grade in this class and a good understanding of the material. The Sapling homework will constitute a 10% portion of your grade. Instructions for logging into Sapling can be found at <http://bit.ly/saplinginstructions>

**Syllabus Changes and Policy:** Any changes in this syllabus I may deem necessary during the semester will be announced in class and made available in writing. I reserve the right to revise the syllabus and grading policies at any time.

## Quizzes:

Quizzes will be given approximately monthly (see schedule for dates). The four quizzes will consist of approximately 25 short answer / calculation / structure and/or multiple-choice questions. Quizzes are worth 60% of the course grade and will cover the material stated on the lecture schedule (2-4 chapters per quiz). Study questions will be provided, and I try to provide supplemental review sessions. The quizzes will be given during the first hour of the class. Lecture will follow. *Your lowest quiz grade will be dropped (we all have bad days).*

## Final Exam:

The ACS standardized Biochemistry Exam will be used as the final exam. The final is required for all students. It is worth 20% of your course grade and will be given during finals week in December (TBA).

## Grade Calculation & Policies:

Class Participation	10 %
Sapling Homework	10 %
4 Quizzes (lowest dropped, remaining three are 20% each)	60 %
Final Exam (ACS)	20 %
Total	100 %

**Points are tentative and subject to change by the instructor.**

Grades will be available at the next regularly-scheduled course meeting. For Finals, final grades will be available from me in person on Friday of finals week. Grades will be available by web and kiosk on after the end of the term at <http://msudenver.edu/studenthub/>.

**FERPA policies prohibit me from releasing your grades via phone or email unless you register with the Registrar's office and obtain a non-identifying security code.**

**CHE 4310 Learning objectives:** Upon completion of this course the student should be able to:

1. Use the Henderson-Hasselbalch equation and knowledge of buffers to calculate how to make a specific buffer a given pH
2. Identify and name the 20 standard amino acids, their functional groups, and classify as hydrophobic or hydrophilic
3. Discuss protein structure (primary, secondary, tertiary and quaternary structures)
4. Calculate  $K_m$  and  $V_{max}$  from kinetic data from enzymes
5. Distinguish between the kinetic effects of competitive, uncompetitive, and mixed inhibitors
6. Name the structures of the common monosaccharides and disaccharides
7. Identify the structures of the five major nucleotides and describe how base composition affects DNA stability
8. Describe the process of DNA cloning and at least one system that can be used for expression of recombinant proteins
9. Identify differences in the chemical composition and structure of RNA polymers compared to DNA
10. Explain how polymerase chain reaction (PCR) works
11. Recognize the structures of fatty acids, triacylglycerols, phosphoglycerides, sphingolipids, and cholesterol
12. Explain the effects of fatty acid saturation on membrane fluidity
13. Explain why ATP is a high-energy compound
14. Calculate ATP costs and yields from all pathways studied: glycolysis, gluconeogenesis, citric acid cycle, glycogen metabolism
15. Compare different modes of regulation of metabolism, including feedback inhibition, covalent modification of enzymes, and gene expression.
16. Describe how glycolysis and gluconeogenesis are coordinately regulated
17. Relate the concepts of reduction potential and free energy
18. Describe the role of the proton gradient in the function of ATP synthase
19. Diagram how glycolysis, the citric acid cycle, the electron transport chain, and ATP synthase are linked.
20. Explain why humans breathe oxygen and exhale carbon dioxide

## Administrative Syllabus policies

Students are responsible for full knowledge of the provisions and regulations pertaining to all aspects of their attendance at MSU Denver, and should familiarize themselves with the policies found in the MSU Denver Catalog: [MSU Denver Catalog](https://msudenver.edu/las/studentinformation/forms/). For more information and recent updates, go to the CLAS website: <https://msudenver.edu/las/studentinformation/forms/>

**NOTE: If you have any difficulty accessing the hyperlinks in this document, please inform the instructor.**

## Advising

The Chemistry department has advising hours for all faculty (and I'm happy to give advice in office hours), but by far our best resource is our dedicated academic advisor, Katie Nittmann ( [knittman@msudenver.edu](mailto:knittman@msudenver.edu) ).

## CHE 4310 Lecture Schedule (subject to change)

Spring 2020

Week	Dates	Lecture Topics	Reading	Sapling
1	Jan 21 and 23	• Lecture 1: Introduction, Water & Buffers	Chapters 1 and 2	---
2	Jan 28 and 30	• Buffers • Lecture 2: Nucleic Acids	Chapters 2 and 4	• HW 1
3	Feb 4 and 6	• Lecture 3: Nucleic Acids & DNA Technology	Chapter 4	• HW 2
4	Feb 11 and 13	• Lecture 4: Amino Acids • <b>Quiz Feb 13 on Chap 1,2,4</b>	Chapter 5	---
5	Feb 18 and 20	• Lecture 5: Proteins & Protein Structure	Chapters 5 and 6	• HW 4
6	Feb 25 and 27	• Lecture 6: Protein Function	Chapter 7	• HW 5
7	Mar 3 and 5	• Lecture 7: The Energetics of Life	Chapters 7 and 3	• HW 6
8	Mar 10 and 12	• Lecture 8: Enzymes & Kinetics • <b>Quiz Mar 12 on Chap 5,6,7</b>	Chapters 3 and 8	• HW 7
9	Mar 17 and 19	• Enzyme Kinetics • Lecture 9: Lipids & Membranes	Chapters 8 and 10	• HW 3 • HW 8
	Mar 23 to Mar 27	• SPRING BREAK	---	---
10	Mar 31 and Apr 2	• Lecture 10: Carbohydrates • Lecture 11: Metabolism	Chapters 9 and 11	• HW 10
11	Apr 7 and 9	• Lecture 12: Glycolysis & Gluconeogenesis • <b>Quiz Apr 9 on Chap 3,8,9,10</b>	Chapters 11 and 12	• HW 9
12	Apr 14 and 16	• Gluconeogenesis • Lecture 13: TCA Cycle	Chapters 12 and 13	• HW 11
13	Apr 21 and 23	• TCA Cycle	Chapter 13	• HW 12
14	Apr 28 and 30	• Lecture 14: Electron Transport & OxPhos • <b>Quiz Apr 30 on Chap 11,12,13,14</b>	Chapter 14	• HW 13
15	May 5 and 7	• Special Topics / Review	---	• HW 14
FINAL	TBA May 11 to 15	<b>ACS Final Examination (most likely May 14)</b>	---	---

## Resources for CHE 4310 Biochemistry I

- Course Website: <http://BonhamChemistry.com/>
- MSU Denver Tutoring Center: <https://msudenver.edu/sas/tutoringcenter/>
- Good General and Organic Chemistry Review: <http://www.chemguide.co.uk/>
- Free Biochem textbook with links to Youtube lectures:  
<http://biochem.science.oregonstate.edu/files/biochem/ahern/Biochemistry%20Free%20For%20All%20I.I.compressed.pdf>
- Learn how to Program Computers in a Biochemical context (tutorials by Dr. Bonham):
  - Making a buffer calculator: <http://bonhamchemistry.com/resources/interactive-python/>
  - Fitting non-linear curves: <http://bonhamchemistry.com/resources/code-tutorials/>
- Khan Academy Biomolecules: <https://www.khanacademy.org/test-prep/mcat/biomolecules>
- Wiley Interactive Animations:  
<https://www.wiley.com/college/boyer/0470003790/animations/animations.htm>
- Read Primary Literature! <http://scholar.google.com/>